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ABSTRACT

The quality of air inside the schoolhouses of America may have a profound effect on students' ability to concentrate on their lessons. The environmental hazards that influence the quality of the indoor air (IAQ) of our schools have not been well understood. Research evidence suggests that school age children and youth (especially those under the age of 10) exposed to the types of contaminants found inside some buildings are especially vulnerable and at a greater health risk than the adult population. A brief historic review of IAQ includes a discussion of the Clean Air Act of 1970, conservation measures of the early 1970s, and the new types of particles and gases introduced into the indoor air over the last few decades. Some children, those pre-school age to age 10 and special education students, may have health characteristics that compound their risk. Some of the children's unique susceptibilities include (1) developing organs and systems; (2) low immune competency; (3) fragile central nervous systems; (4) immature liver and kidneys; (5) retention of toxins for long periods; (6) skin sensitive to inhaling, ingesting, and absorbing pollutants; and (7) possibly greater exposure to certain hazards. Appended are seven references. (SI)

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ENVIRONMENTALLY RELATED HEALTH HAZARDS IN THE SCHOOLS

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Environmentally Related Health Hazards in the Schools

James B. Andrews and Richard Neuroth

The major purpose of the school program is to provide each generation with the knowledge, values, attitudes and skills needed to make this world a little better place for all of its inhabitants. Millions of children and youth and great numbers of adults apend many of their waking hours in and around the school buildings of our Nation. It has long been an accepted fact that every effort must be made to protect the health and safety of these children and adults.

Educational facilities planners have had the responsibility of overseeing the designing and building of spaces that meet educational curricula requirements. They have had to be aware of the latest information and developments regarding all facets of construction (methods and material used) to ensure that the resulting structures were as free from environmental hazards as possible.

Environmental Hazards

Environmental hazards in and around the schools are numerous. Facilities planners have routinely considered hazards inherent in potential sites (proximity to noise, heavy traffic, industrial activity, etc.) prior to site selection. Public health officials have tried to ensure that the water supply and food prepared on site was free from lead or other heavy metal, pesticide and bacterial contamination. National consumer groups have lobbied for laws to control the selection of materials used in art and stage craft classes they believe have severe implications for the long term health of those who use them.

The environmental hazards which influence the quality of the indoor air (IAQ) of our schools, however, have not been that well understood. And until recently were of no real concern. The facts are that prior to mid-1970s only the indoor air quality of the nations industrial and manufacturing sectors were thought to pose a serious health threat to those working therein. Environmental scientist are just now developing a research base on the many and varied hazards that effect the quality of air we breath indoors and its health consequences for building occupants. Research evidence suggests that school age children and youth (especially those under the age of ten) exposed to the types of contaminants found inside some buildings are especially vulnerable and at a greater health risk than the adult population. The more that is learned about IAQ, the more we need to be concerned for the well-being of those who work in and go to school in our nation.

Indoor Air Quality (IAQ): A Brief Historic Review

The National Academy of Science in the introduction to its 1987 report on indoor air quality [1] made this observation about the historical concern for IAQ:

> "Although the impact of indoor air quality on occupant health and well-being is a serious concern today, the subject is not new. Evidence indicates that efforts to control indoor air quality predate recorded history, as illustrated by the judicious placement of warming fires and the presence of vent holes in the roofs of caves. When windows came into use in early Roman architecture, styles and sizes of buildings changed significantly. Gothic architecture embodied advances in structural design that allowed large areas of window to be used without affecting the stability of the wall. Renaissance architecture relied heavily on operable windows for natural ventilation. In fact, detailed prescriptive rules for window sizes were originally developed in Italy during this time. However, when these rules were imported to England in the 1600s and strictly applied to the smaller-scale buildings there, the resulting windows were often too small to be acceptable.
>
> Compromises among needs for shelter, security, safety, and health have been made throughout history. From the discovery of window glazing to the middle of the twentieth century, the shapes and sizes of buildings for human occupancy were closely matched with their ability to utilize natural ventilation to dissipate internally generated thermal and contaminant loads. However, the development of twentieth-century technologies for structures and mechanical systems has permitted decisions about building shapes and sizes to be separated from the needs for natural ventilation. Thus, current concerns about indoor air quality have evolved from fulfilling the basic need for shelter to meeting complex requirements for personal, social, and economic benefits.

IAQ and the Clean Air Act of 1970

When the Clean Air Act was passed in 1970, the quality of indoor air was not even mentioned in the law. Air pollution problems perceived as dangerous to the public health of the nation were out-of-doors. The "mounting dangers to the public health and welfare," as described by the Congress in Title I, were perceived to be caused by "Urbanization, industrial development, and the increasing use of motor vehicles..." [2] Consequently, the law that

was intended to protect and enhance the quality of the nation's air resources gave the United States Environmental Protection Agency (EPA) authority to control a wide variety of air emissions sources and air pollutants that contributed to the degradation of ambient air. EPA interpreted the term "ambient" to apply to outdoor air only.

Except for studies of specialized environments like submarines, space cabins, and the industrial work place, virtually no scientific research had been done on the quality of the air inside buildings. Indoor air pollution and its associated health effects were considered neither serious enough nor pervasive enough to merit national attention.

Energy Conservation and the "tight or sick" building syndrome

The early 1970's ushered in the era of energy consciousness in architecture design and construction practice. There was a national effort to reduce the cost heating and air-conditioning buildings. Some school buildings were constructed primarily of steel, concrete or concrete blocks, new insulating material such as Urea-Formaldehyde (UFFI) and windows that couldn't be opened; thus making them totally dependent on mechanical systems for conditioned indoor air. People working in such mechanically ventilated buildings had no way to control the quality or amount of air in their personal work space. The decision, for example, on how much outside air would be used as make-up, was usually made based on the building owner's desire to conserve rather than on an understanding of impact it would have on the health of building occupants. Not much was known about health consequences of many of the aspects of the new energy conscious design techniques or the many new products used during and after the construction of buildings.

Energy conservation measures instituted during this period had the effect of sealing buildings so tightly that a new phenomenon the "tight or sick building syndrome" [3] began appearing in the literature. Research by the United States Environmental Protection Agency (EPA) and later the National Academy of Science (NAS) on UFFI and other materials found in various indoor environments concluded that (a) pollutant concentrations were often much higher indoors than they were outdoors, and (b) indoor air pollutant is a major cause of disease, illness, and problems.

IAQ is Thrust onto the Front Burner

Over the past two decades, there has been an upsurge in public awareness and governmental concern about the quality of the air we breathe while inside our homes, schools, and work places. On the federal leverl, several agencies began developing different

programs in response to specific indoor air quality problems. In large measure, it wasn't until scientists began to better understand the adverse effects of three indoor air pollutants--asbestos,[4] radon,[5] and formaldehyde--that they began to be concerned about IAQ in general.

The types of particles and gases introduced into the indoor air by new products have grown rapidly in the last few decades. New products are introduced each year for use during and after the construction of buildings. The effects on humans of the materials in these products often can not be forecast. Many years can pass before the dangers of a chemical are realized and brought into public awareness. Product technology has given us materials that directly affect the quality of indoor air in ways that are of increasing concern to building planners and users.

The major impetus for moving IAQ higher up the national agenda came from the National Academy of Sciences' 1981 Report[6] saying that indoor pollution is "a major cause of disease, illness, and problems" and that IAQ was clearly much bigger thatn the formaldehyde problem alone.

The Concern for IAQ in Educational Facilities

Responsible school administration and educational facilities personnel have generally operated the school buildings in this nation in a safe and healthy manner, and will continue to do so. However, as new technology and new information are brought forth and there is a heightened level of awareness that certain hazards may contribute to potential problems with indoor air quality, administrators are called upon to be even more bigilant. School administrators should be especially interested in understanding and managing IAQ in schools because of the unique susceptibilities to all contaminants of young children. They are a a greater risk than the adult population. Some children, those pre-school age to age 10 and special education students may have health characteristics that compound their risk. Some of the unique susceptibilities[7] are include:

1. Their organs and systems are still developing and disruption and disturbance, particularly at critical developmental periods, may result in irreparable damage.

2. Their immune competence (self-repairability) may not be as great as adults'.

3. Their central nervous systems are mor fragile than adults'.

4. Immature liver and kidneys are less able to degrade and excrete toxins.

5. Children's bodies can potentially retain toxins for long periods of time.

6. They inhale, ingest, and absorb through their more sensitive skin more pollutants per unit of body weight than most grown-ups do.

7. Their exposure to certain hazards (habits, such as putting everything in their mouths) may be greater.

Those responsible for school facilities have a moral obligation to do everything possible to mitigate conditions that may contribute to poor indoor air. To do less is to expose school age children and youth, as well as the adults that provide them services, to unnecessary risks to the health and well-being.

Summary

Educators are rightly alarmed by the knowledge that the quality of the air inside the schoolhouses of America may have a profound effect on students' ability to concentrate on their lessons. The school administration has a special obligation to develop a sensitivity to IAQ issues and to obtain the necessary knowledge and skill to create as safe a learning environment as is technologically and humanly possible.

Notes:

1. National Research Council. (1987). Policies and procedures for control of indoor air quality. Washington, DC: National Academy Press.

2. United States Environmental Protection Agency. (1987). EPA indoor air quality implementation plan. Appendix A: Preliminary indoor air pollution information assessment (EPA-600/8-87-014) Research Triangle Park. NC: EPA

3. Sick building syndrome refers to on illness outbreak among occupants, with no secondary spread of the illness to others outside the building with whom affected individuals come into contact. Adverse reactions to indoor environments typically fall into categories. feelings of discomfort (e.g., thermal discomfor, unpleasant odor, lack of air movement, inadequate lighting, excessive noise) and short-term health effects (e.g., mucous membrane irritation, allergic reaction, skin rash, headaches, nausea, fatique). Among the potentail causes of building related illness are infectious agents, allergic agents, physical parameters (e.g., temperature, ventilation), chemical contaminants, and psychosocial factors (e.g., job-related stress).

4. As far back as the mid-1960's, the cancer risk of asbestos became known to federal health agencies and subsequently led to EPA programs to address asbestos containment and removal, especially in schools.

5. A high incidence of lung cancer among underground miners exposed to elevated levels of radon gas was observed on the 1970's, and in 1979, EPA set initail radon guidelines for remedial action in existing homes and new home construction on reclaimed phosphate lands in the State of Florida. The discovery of extremely high levels of radon in the Reading Prong geological formation in New Jersey, Pennsylvania, and New York led to development of EPA's Radon Action Program in 1985 and agin helped to focus national attention on indoor air pollution in general.

6. National Research Council. (1981). Indoor pollutants. (Committee on indoor pollutants. Board on Toxicology and Environmental Health Hazards). Washington, DC: National Academy Press.

7. Noyes, D. (1987). Indoor pollutants: Environmental hazards to young children. Young Children, September, 58.